**Ministry Of Education**

**Sharjah Educational Zone**

**Student :**

**Class :**

## Introduction :

The **human eye** is an organ which reacts to light for several purposes. As a conscious [sense organ](http://en.wikipedia.org/wiki/Sensory_system), the [mammalian eye](http://en.wikipedia.org/wiki/Mammalian_eye) allows [vision](http://en.wikipedia.org/wiki/Visual_perception). [Rod](http://en.wikipedia.org/wiki/Rod_cell) and [cone](http://en.wikipedia.org/wiki/Cone_cell) cells in the [retina](http://en.wikipedia.org/wiki/Retina) allow conscious light perception and vision including color differentiation and the perception of depth. The human eye can distinguish about 10 million colors.

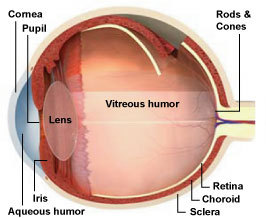
In common with the [eyes of other mammals](http://en.wikipedia.org/wiki/Mammalian_eye), the human eye's non-image-forming [photosensitive ganglion cells](http://en.wikipedia.org/wiki/Photosensitive_ganglion_cell) in the retina receive the light signals which affect adjustment of the size of the pupil, regulation and suppression of the hormone [melatonin](http://en.wikipedia.org/wiki/Melatonin) and [entrainment](http://en.wikipedia.org/wiki/Entrainment_%28chronobiology%29) of the [body clock](http://en.wikipedia.org/wiki/Circadian_rhythm).

The eye is not properly a sphere, rather it is a fused two-piece unit. The smaller frontal unit, more curved, called the cornea is linked to the larger unit called the sclera. The corneal segment is typically about 8 mm (0.3 in) in radius. The sclerotic chamber constitutes the remaining five-sixths; its radius is typically about 12 mm. The cornea and sclera are connected by a ring called the limbus. The iris – the color of the eye – and its black center, the pupil, are seen instead of the cornea due to the cornea's transparency. To see inside the eye, an [ophthalmoscope](http://en.wikipedia.org/wiki/Ophthalmoscope) is needed, since light is not reflected out. The fundus (area opposite the pupil) shows the characteristic pale optic disk (papilla), where vessels entering the eye pass across and optic nerve fibers depart the globe.

## How the Human Eye Works

The human eye belongs to a general group of eyes found in nature called “[camera-type eyes](http://www.livescience.com/3914-nature-inspires-design-eyes.html).” Instead of film, the human eye focuses light onto a light sensitive membrane called the retina.

Here’s how the human eye is put together and how it works:

The cornea is a transparent structure found in the very front of the eye that helps to focus incoming light. Behind the cornea is a colored ring-shaped membrane called the iris. The iris has an adjustable circular opening called the pupil, which can expand or contract depen

ding on the amount of light entering the eye.

A clear fluid called the aqueous humor fills the space between the cornea and the iris.

Situated behind the pupil is a colorless, transparent structure called the crystalline lens. Ciliary muscles surround the lens. The muscles hold the lens in place but they also play an important role in vision.

When the muscles relax, they pull on and flatten the lens, allowing the eye to see objects that are far away. To see closer objects clearly, the ciliary muscle must contract in order to thicken the lens.

The interior chamber of the eyeball is filled with a jelly-like tissue called the vitreous humor. After passing through the lens, light must travel through this humor before striking the sensitive layer of cells called the retina.

The retina is the innermost of three tissue layers that make up the eye. The outermost layer, called the sclera, is what gives most of the eyeball its white color. The cornea is also a part of outer layer.

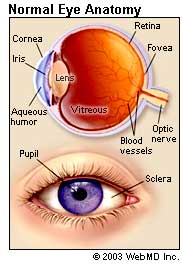
The middle layer between the retina and sclera is called the choroid. The choroid contains blood vessels that supply the retina with nutrients and oxygen and removes its waste products.

Embedded in the retina are millions of light sensitive cells, which come in two main varieties: rods and cones.

Rods are good for monochrome vision in poor light, while cones are used for color and for the detection of fine detail. Cones are packed into a part of the retina directly behind the retina called the fovea.

When light strikes either the rods or the cones of the retina, it's converted into an electric signal that is relayed to the brain via the optic nerve. The brain then translates the electrical signals into the images we see.

## How the Eye Sees

Travel inside the eyes -- our window to the world -- and learn how they allow us to see objects both near and far.

In order to see, there must be light. Light reflects off an object and -- if one is looking at the object -- enters the eye.

The first thing light touches when entering the eye is a thin veil of tears that coats the front of the eye. Behind this lubricating moisture is the front window of the eye, called the cornea. This clear covering helps to focus the light.

On the other side of the cornea is more moisture. This clear, watery fluid is the *aqueous humor*. It circulates throughout the front part of the eye and keeps a constant pressure within the eye.

After light passes through the aqueous humor, it passes through the pupil. This is the central circular opening in the colored part of the eye -- also called the iris. Depending on how much light there is, the iris may contract or dilate, limiting or increasing the amount of light that gets deeper into the eye. The light then goes through the lens. Just like the lens of a camera, the lens of the eye focuses the light. The lens changes shape to focus on light reflecting from near or distant objects.

This focused light now beams through the center of the eye. Again the light is bathed in moisture, this time in a clear jelly known as the vitreous. Surrounding the vitreous is the retina.

Light reaches its final destination within the photo receptors of the retina: the retina is the inner lining of the back of the eye. It's like a movie screen or the film of a camera. The focused light is projected onto its flat, smooth surface. However, unlike a movie screen, the retina has many working parts:

* **Blood vessels.** Blood vessels within the retina bring nutrients to the retina's nerve cells.
* **The macula.** This is the bull's-eye at the center of the retina. The dead center of this bull's eye is called the fovea. Because it's at the focal point of the eye, it has more specialized, light sensitive nerve endings, called photoreceptors, than any other part of the retina.
* **Photoreceptors.** There are two kinds of photoreceptors: rods and cones. These specialized nerve endings convert the light into electro-chemical signals.
* **Retinal pigment epithelium.** Beneath the photoreceptors is a layer of dark tissue known as the retinal pigment epithelium, or RPE. These important cells absorb excess light so that the photoreceptors can give a clearer signal. They also move nutrients to (and waste from) the photoreceptors to the choroid. Bruch's membrane separates the choroid from the RPE.
* **The choroid.** This layer lies behind the retina and is made up of many fine blood vessels that supply nutrition to the retina and the retinal pigment epithelium.
* **Sclera.** Normally light does not get as far as this layer. It is the tough, fibrous, white outside wall of the eye connected to the clear cornea in front. It protects the delicate structures inside the eye.

Signals sent from the photoreceptors travel along nerve fibers to a nerve bundle which exits the back of the eye, called the optic nerve. The optic nerve sends the signals to the visual center in the back of the brain.

Now light, reflected from an object, has entered the eye, been focused, converted into electro-chemical signals, delivered to the brain and interpreted or "seen" as an image.

## process of vision

Light waves from an object (such as a tree) enter the eye first through the [cornea](http://www.tedmontgomery.com/the_eye/cornea.html), which is the clear dome at the front of the eye.  The light then progresses through the [pupil](http://www.tedmontgomery.com/the_eye/iris.html#pupil), the circular opening in the center of the colored [iris](http://www.tedmontgomery.com/the_eye/iris.html).

Fluctuations in incoming light change the size of the eye’s pupil.  When the light entering the eye is bright enough, the pupil will constrict (get smaller), due to the [pupillary light response](http://www.tedmontgomery.com/the_eye/reflex.html).

Initially, the light waves are bent or converged first by the cornea, and then further by the [crystalline lens](http://www.tedmontgomery.com/the_eye/lens.html) (located immediately behind the iris and the pupil), to a nodal point (N) located immediately behind the back surface of the lens.  At that point, the image becomes reversed (turned backwards) and inverted (turned upside-down).

The light continues through the [vitreous humor](http://www.tedmontgomery.com/the_eye/vitreous.html), the clear gel that makes up about 80% of the eye’s volume, and then, ideally, back to a clear focus on the [retina](http://www.tedmontgomery.com/the_eye/retina.html), behind the vitreous.  The small central area of the retina is the [macula](http://www.tedmontgomery.com/the_eye/macula.html), which provides the best vision of any location in the retina.  If the eye is considered to be a type of camera (albeit, an extremely complex one), the retina is equivalent to the film inside of the camera, registering the tiny photons of light interacting with it.

Within the layers of the retina, light impulses are changed into electrical signals.  Then they are sent through the [optic nerve](http://www.tedmontgomery.com/the_eye/optcnrve.html), along the [visual pathway](http://www.tedmontgomery.com/the_eye/optcnrve.html#visual_pathway), to the occipital cortex at the posterior (back) of the brain.  Here, the electrical signals are interpreted or “seen” by the brain as a visual image.

Actually, then, we do not “see” with our eyes but, rather, with our brains.  Our eyes merely are the beginnings of the visual process.

## myopia, hyperopia, astigmatism

If the incoming light from a far away object focuses before it gets to the back of the eye, that eye’s refractive error is called “myopia” (nearsightedness).  If incoming light from something far away has not focused by the time it reaches the back of the eye, that eye’s refractive error is “hyperopia” (farsightedness).

In the case of “astigmatism,” one or more surfaces of the cornea or lens (the eye structures which focus incoming light) are not spherical (shaped like the side of a basketball) but, instead, are cylindrical or toric (shaped a bit like the side of a football).  As a result, there is no distinct point of focus inside the eye but, rather, a smeared or spread-out focus.  Astigmatism is the most common refractive error.

## presbyopia (“after 40” vision)

After age 40, and most noticeably after age 45, the human eye is affected by [presbyopia](http://www.tedmontgomery.com/the_eye/lens.html#presbyopia).  This natural condition results in greater difficulty maintaining a clear focus at a near distance with an eye which sees clearly far away.

Presbyopia is caused by a lessening of flexibility of the [crystalline lens](http://www.tedmontgomery.com/the_eye/lens.html), as well as to a weakening of the ciliary muscles which control lens focusing.  Both are attributable to the aging process.

An eye can see clearly at a far distance naturally, or it can be made to see clearly artificially, such as with the aid of [eyeglasses](http://www.tedmontgomery.com/the_eye/glasses.html) or contact lenses, or else following a photorefractive procedure such as LASIK (laser-assisted in situ keratomileusis).  Nevertheless, presbyopia eventually will affect the near focusing of every human eye.

## eye growth

The average newborn’s eyeball is about 18 millimeters in diameter, from front to back (axial length).  In an infant, the eye grows slightly to a length of approximately 19½ millimeters.

The eye continues to grow, gradually, to a length of about 24-25 millimeters, or about 1 inch, in adulthood.  A ping-pong ball is about 1½ inch in diameter, which makes the average adult eyeball about 2/3 the size of a ping-pong ball.

The eyeball is set in a protective cone-shaped cavity in the skull called the “orbit” or “socket.”  This bony orbit also enlarges as the eye grows.

## extraocular muscles

The orbit is surrounded by layers of soft, fatty tissue.  These layers protect the eye and enable it to turn easily.

Traversing the fatty tissue are three pairs of [extraocular muscles](http://www.tedmontgomery.com/the_eye/eom.html), which regulate the motion of each eye: the medial & lateral rectus muscles, the superior & inferior rectus muscles, and the superior & inferior oblique muscles.

## eye structures

Several structures compose the human eye.  Among the most important anatomical components are the [cornea](http://www.tedmontgomery.com/the_eye/cornea.html), [conjunctiva](http://www.tedmontgomery.com/the_eye/cnjnctva.html), [iris](http://www.tedmontgomery.com/the_eye/iris.html), [crystalline lens](http://www.tedmontgomery.com/the_eye/lens.html), [vitreous humor](http://www.tedmontgomery.com/the_eye/vitreous.html), [retina](http://www.tedmontgomery.com/the_eye/retina.html), [macula](http://www.tedmontgomery.com/the_eye/macula.html), [optic nerve](http://www.tedmontgomery.com/the_eye/optcnrve.html), and [extraocular muscles](http://www.tedmontgomery.com/the_eye/eom.html).

## Eye Anatomy

## http://www.tedmontgomery.com/the_eye/graphics/eyediagram.gif

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| **1** [**posterior compartment**](http://www.tedmontgomery.com/the_eye/glossary/P.html#posteriorcompartment) **2** [**ora serrata**](http://www.tedmontgomery.com/the_eye/glossary/O.html#oraseratta) **3** [**ciliary muscle**](http://www.tedmontgomery.com/the_eye/glossary/C.html#ciliarymuscle) **4** [**ciliary zonules**](http://www.tedmontgomery.com/the_eye/glossary/C.html#ciliaryzonules) **5** [**canal of Schlemm**](http://www.tedmontgomery.com/the_eye/glossary/C.html#canalofSchlemm) **6** [**pupil**](http://www.tedmontgomery.com/the_eye/glossary/P.html#pupil) **7** [**anterior chamber**](http://www.tedmontgomery.com/the_eye/glossary/A.html#anteriorchamber) **8** [**cornea**](http://www.tedmontgomery.com/the_eye/glossary/C.html#cornea) **9** [**iris**](http://www.tedmontgomery.com/the_eye/glossary/I.html#iris) **10** [**lenticular cortex**](http://www.tedmontgomery.com/the_eye/glossary/L.html#lenticularcortex) |  | **11** [**lenticular nucleus**](http://www.tedmontgomery.com/the_eye/glossary/L.html#lenticularnucleus) **12** [**ciliary process**](http://www.tedmontgomery.com/the_eye/glossary/C.html#ciliaryprocesses) **13** [**conjunctiva**](http://www.tedmontgomery.com/the_eye/glossary/C.html#conjunctiva) **14** [**inferior oblique muscle**](http://www.tedmontgomery.com/the_eye/glossary/I.html#inferior_oblique) **15** [**inferior rectus muscle**](http://www.tedmontgomery.com/the_eye/glossary/I.html#inferior_rectus) **16** [**medial rectus muscle**](http://www.tedmontgomery.com/the_eye/glossary/M.html#medial_rectus) **17** [**retinal arteries**](http://www.tedmontgomery.com/the_eye/glossary/R.html#retinalarteries) **/** [**veins**](http://www.tedmontgomery.com/the_eye/glossary/R.html#retinalveins) **18** [**optic disc**](http://www.tedmontgomery.com/the_eye/glossary/O.html#opticdisc) **19** [**dura mater**](http://www.tedmontgomery.com/the_eye/glossary/D.html#duramater) **20** [**central retinal artery**](http://www.tedmontgomery.com/the_eye/glossary/C.html#centralretinalartery) |  | **21** [**central retinal vein**](http://www.tedmontgomery.com/the_eye/glossary/C.html#centralretinalvein) **22** [**optic nerve**](http://www.tedmontgomery.com/the_eye/glossary/O.html#opticnerve) **23** [**vorticose vein**](http://www.tedmontgomery.com/the_eye/glossary/V.html#vorticosevein) **24** [**bulbar sheath**](http://www.tedmontgomery.com/the_eye/glossary/B.html#bulbarsheath) **25** [**macula lutea**](http://www.tedmontgomery.com/the_eye/glossary/M.html#macula) **26** [**fovea centralis**](http://www.tedmontgomery.com/the_eye/glossary/F.html#foveacentralis) **27** [**sclera**](http://www.tedmontgomery.com/the_eye/glossary/S.html#sclera) **28** [**choroid**](http://www.tedmontgomery.com/the_eye/glossary/C.html#choroid) **29** [**superior rectus muscle**](http://www.tedmontgomery.com/the_eye/glossary/S.html#superior_rectus) **30** [**retina**](http://www.tedmontgomery.com/the_eye/glossary/R.html#retina) |

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